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Solar rotational periodicity in geosynchronous relativistic electron flux variation and its relationship with solar wind conditions in solar cycles 23 and 24

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The interplanetary magnetic field (IMF) and geomagnetic field are closely coupled to each other such that the solar wind, IMF and magnetospheric parameters often have similar periodic variations, as reported in some previous studies. In a recent study based on wavelet analysis, we have confirmed that IMF Bz in GSM coordinate has periodic variations at the solar rotational period and/or its harmonics predominantly in spring and fall seasons by Russell-McPherron effect when associated with well-organized IMF sector structure. In the present work, we extend the same analysis to geosynchronous relativistic electron (>2MeV) fluxes and other related parameters. We find that geosynchronous relativistic electrons often, but not always, exhibit periodic variations at the solar rotational period and sometimes its harmonics. The periodic properties of the geosynchronous relativistic electron fluxes are most closely correlated with those of AE index among the other parameters we tested. Furthermore, this is also closely related to periodic changes in the universal coupling function, $d\Phi_{MP}$ /dt, which is a coupling function suggested by Newell et al. (2007) to represent the rate at which the solar wind magnetic flux is opened at the magnetopause. However, the extent to which the coupling holds between geosynchronous relativistic electrons and the $d\Phi_{MP}$/dt function depends on solar cycle and phase. We will discuss implications of this result, including the usefulness and limitations of this coupling function.